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ABSTRACT

To expand sign language for simultaneous use along with fingerspelling and speech, signs were created for English terms frequently used in the classroom. Those signs judged very good or excellent in clarity and appearance were retained and selected ones taught by closed circuit television to Gallaudet students. Entering preparatory students recognized the English equivalent of about 66% of 92 new signs upon initial presentation. Seven months later they recognized about 75%. Upperclassmen were taught signs for specific subject matter in 12 areas and recognized about 80% initially. It was suggested that their higher rate of recognition resulted from increased familiarity with sign language and with the subject content. A listing is provided of the terms developed. (Author/JD)

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Project No. 6-1924
Contract No. OE 2-6-061924-1890

New Signs for Instructional Purposes

BORNSTEIN, H.
KANNAPELL, B. M.
Gallaudet College
Washington, D.C. 20002

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SUMMARY

At Gallaudet College and elsewhere teachers communicate with deaf students by means of the simultaneous method. This is the simultaneous use of speech, the language of signs, and the manual alphabet (fingerspelling). Since fingerspelling is slower than other communication modes, it is usually desirable to sign as much as possible when lecturing. Unfortunately, the sign language has only about 2000 signs. It was believed, therefore, that both formal and informal instruction would be facilitated if the sign language could be expanded and if these new signs were effectively taught to users of the simultaneous method.

During the first two years of the project, faculty nominated English terms which were frequently used in class but for which no signs existed. New signs were created for as many of these terms as possible by both systematic and spontaneous procedures. The new signs were evaluated on the basis of their clarity and appearance. Only those judged very good or excellent were retained.

A large number of new signs (92) was taught by closed circuit TV to a large group of entering preparatory Gallaudet students. Upon initial presentation the students were able, on the average , to recognize the English equivalent of about two-thirds of the signs. After only one additional presentation, average recognition was about 90% correct. This result was achieved with a group of students only half of whom considered themselves fluent in the sign language.

When the same type of presentation was used to teach new signs for a specific subject matter in 12 different subjects to juniors and seniors, the technique was even more successful. The upperclassmen, on the average, were able to recognize about 80% of the English equivalents upon initial presentation. This greater success can probably be attributed to increased fluency in the sign language and greater familiarity with the subject matter vocabulary.

A considerable amount of retention was also evident seven months later in a spring testing of the new preparatory students. At this time they recognized about three-fourths of the group of 92 signs, a saving of 43.5% of the gain that they had achieved after their first learning session.

The principal product of the project was a book of line drawings of 465 new signs: Signs for Instructional Purposes, by Kannapell, B.M., Hamilton, L.B., and Bornstein, H. Four thousand copies were printed and distributed without charge to persons involved in the education of the deaf.

The final part of this report deals with some of the characteristics of the sign language itself. The procedures used in this study yielded 465 new signs which can be categorized as follows: 43% are existing signs modified by manual alphabet letters;

22% are compounds of existing signs and/or letters; 29% are entirely new signs; and 6% are a miscellaneous combination of the previous categories. In short, about 70% of these new signs represent minor modification or combinations of previously existing signs. In part, this reflects the procedures used to develop the new signs, but it also suggests that the existing sign language has a great deal of explanatory power even for the rather abstract vocabulary involved in this study.

The other major conclusions which may be drawn from this study are that differences in recognizability, acquisition, and retention of new signs can be attributed to the method by which these new signs were generated. Compounds were superior to other forms when measured against the learning criteria used in this study. However, the differences are relatively small and probably should not seriously affect the acceptance and use of any kind of sign into the sign language.

INTRODUCTION

Instructors at Gallaudet College, a liberal arts college for deaf students, use a distinctive means of communication, the "simultaneous method". This method consists of the simultaneous use of two parallel systems of communication: oral (a combination of sound and lip movements) and manual (a combination of the sign language and fingerspelling.) The redundancy resulting from this parallel presentation is intended to maximize the probability that the deaf student will receive all of the information transmitted by the lecturer.

Each separate system has some limitations for deaf persons. At best, only those deaf students with a certain amount of residual hearing have even a limited ability to discriminate between speech sounds, and only a portion of the speech sounds can be discriminated from the lips of the speaker by those able to read lips. The central aspect of manual communication is the sign language. Each hand sign represents a concept rather than a specific English word. The sign language is complemented by fingerspelling when a precise word must be communicated and when it is desired to communicate a concept for which no sign exists. Fingerspelling which is a manual representation of the English alphabet has a slower transmission rate, however, than the other methods. A comfortable reading speed for very experienced readers is about sixty words per minute (Bornstein, 1965).

The simultaneous method in the hands of a practiced user results in rapid and fluent conversations and seems efficient in discussions and lectures on non-technical subject matter. However, manual communication has a serious shortcoming for lectures on complex material. Because the sign language is limited in size,[1] much of the lecture must be fingerspelled. In addition to the resulting reduced rate of transmission, readers seem to tire under too prolonged an exposure to spelling.

In actual classroom use these shortcomings are partially offset by a variety of ingenious strategems to expand and/or make the sign language more flexible. Instructors use one or more of the following devices: They

a. invent a new sign for use for a specified time period, e.g., an entire semester

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[1] The most comprehensive published dictionary on the Sign Language, Stokoe, Casterline, and Croneberg, Dictionary of American Sign Language, Washington, D. C.: Gallaudet Press, 1965, has an index of approximately 2000 signs. A second dictionary effort by Martin Sternberg is in press and may include a somewhat larger collection of signs.

b. arbitrarily assign a new meaning to an already existing sign,

c. list terms on the blackboard and point to them when appropriate,

d. use one letter of a given term on the list to cue the students to that term,

e. abbreviate freely.

All of these devices can be characterized as situation-bound: neither the teacher nor the student can readily use these signs outside the classroom without additional explanation or material. And instructors probably vary a good deal in their ability to utilize some of these techniques.

In spite of the foregoing many instructors still claim that an excessive number of frequently used words must be spelled. Of equal import, situation-bound signs, because of their nature, probably do not enter into the body of the language in any quantity. It is possible, therefore, that the very ease with which situation-bound signs can be devised for the classroom limits the natural growth of the sign language. And the very important learning experiences that take place outside the classroom may suffer from using a relatively slow-growing language.

Aside from its use at the college, the simultaneous method is regularly employed in a wide variety of situations. It is often used, but never advertised, in teaching at the secondary or advanced levels in many schools for the deaf throughout the United States. It is routinely used in deaf adult education courses. Finally, it is regularly employed in a variety of vestibule or preparatory programs at the National Technical Institute for the Deaf, San Fernando Valley State College, Delgado College, Seattle Junior College, and Saint Paul Community College.

In recent years, the above named schools have accepted sizable numbers of deaf students into their regular programs of instruction. Deaf students sit in on "conventional" classes and receive much, perhaps most, of their information from interpreters who use a sort of "soundless" method, i.e., the interpreter mouthes rather than sounds out the English words. This procedure is used over a wide range of subject matters. It is important to note that these interpreters rarely have any control over either the pace of the complexity of the oral channel of communication. This suggests that a more rapid and precise manual communication may be required in this setting than when it (the manual communication)is used as a component in the simultaneous method. Furthermore, an interpreter usually has less opportunity than an instructor to devise situation-bound signs because of his limited control over the communication situation. It seems likely, therefore, that new signs would be as useful for interpreters as for instructors who use the simultaneous method. Recent experience bears this out. Interpreters requested and began using the signs created in this project well before this report could be completed. At least

two schools, San Fernando Valley State College and the National Technical Institute for the Deaf are using the new signs officially, while some may be using them unofficially. Others, then, apparently share our original assumption that new signs would enhance the education of the deaf student.

An unpublished pilot study by Rosenblatt and Bornstein (1964) is illustrative of an effort to meet the problem of a limited number of signs in just one subject matter: psychology. The effort began with an examination of introductory psychology texts for words or terms used frequently, which were judged important, and which had no counterpart in the sign language. A basic vocabulary list of about 75 terms was produced. From this list a total of 49 "acceptable" new signs was created following any of the four different logics described below.

Subsequently, two experimental instruments were made: an eight mm color motion picture film of the 49 new signs and a multiple (four) choice test exactly paralleling the film contents. The film followed this format: first the depiction of a sign being made; second, a pause during which the learner might interpret the sign; and last, a printed English "equivalent" of the sign. This pattern was followed for all 49 signs. After the student saw the sign on the film, he chose the test alternative he believed corresponded to the English equivalent of the film sign. The filmed caption showed him the correct answer.

The first showing of the film constituted the first trial. The percentage of correct answers on this first trial represented a measure of the "recognizability" of the new signs. After a moment's rest, the motion picture was run for a second and then a third time. A fresh answer sheet was supplied to the student for each film showing.

Although the major concern of the study was the comparison of four different sign generation logics, of moment here is the fact that about half (.57) of the new signs were correctly recognized on the first trial. On the third and last trial the percentage correct had leaped to 95. It was clear, therefore, that a relatively small number of new signs could be learned well quickly. What could not be tested in this small study was the difficulty involved in creating a large number of new signs, the effectiveness of teaching this large number, and the ability to remember new signs. Needless to say, all of these problems are central to any effort to generate a large number of new signs for instructional purposes.

SPECIFIC OBJECTIVES

It is apparent that a more rapid and precise manual communication is needed in the classroom, on the lecture platform and wherever else it is desired to speak accurately and at a normal rate. The basic objective of this study was to demonstrate that the sign language could be systematically expanded for instructional use.

The techniques used for this expansion will be described so that others can generate signs to fit their own needs. In addition, all new signs will be disseminated as widely as possible.

To accomplish the above it was specifically desired to:

a. add from 500 to 100 new signs to the existing 2000,

b. test how well these new signs were (1) recognized, (2) acquired, and (3) retained,

c. provide improved methods of teaching the new signs both during and after the course of this project.

METHODS

A. Term specification:

Representatives of 15 academic departments participated directly in the project. Faculty from the foreign language departments (Romance Languages, Russian and German) were indirect participants as they reviewed the terms nominated by the English faculty and indicated that they were equally appropriate for their own disciplines. The Philosophy, Home Economics , Printing and Business Administration Departments did not participate.

Although it had been intended originally that both students and faculty nominate terms, it was found that the faculty constituted almost the sole reliable source for new signs. When students were requested to nominate terms it was found they were not sufficiently facile with a given subject matter to approach the task meaningfully Faculty, therefore, nominated terms that they believed were important for the subject matter, used frequently for lecture and discussion, and made up of a large number of letters. In some cases project personnel aided faculty by by reproducing portions of the indexes of pertinent introductory and basic texts. Teachers scrutinized the lists and accepted those terms which met the above stated criteria. Faculty from each discipline worked independently. Terms nominated by more than one department were grouped into broader clusters such as science and mathematics, social sciences, humanities, and professional studies.

These activities resulted in a pool of pproximately 75 to 100 terms for each subject matter area. It was anticipated that acceptable new signs could be created for one third to one-half of the terms nominated.

B. Sign Creation:

In the pilot study cited above four different ways of creating signs were used. They were:

a. A compound: the combination of two existing signs; e.g., the sign for "day" followed by the sign for "now", represents the sign for "today".

b. An initial designation or letter grafted onto an existing sign, e.g., the letter "p" incorporated into the existing sign for "doctor" results in a sign meaning "psychiatrist".

c. A totally new sign which incorporates a manual alphabet letter as a part of the sign.

d. A totally new sign without any manual alphabetic designation.

In that study it was found that modified existing signs proved easiest to recognize immediately while completely new signs proved the most difficult. Compound signs and new signs incorporating an existing letter fell between these two extremes.

Early in this investigation it was recognized that a compound of existing elements could logically include letters of the manual alphabet as well as signs. Accordingly, this category was broadened. It also became apparent that some signs fell into more than one category and thus required a miscellaneous category. A tabular breakout of the final categories employed is presented below under analysis of results.

The procedure used to create signs followed this general pattern. For each English term nominated, a search of the existing sign vocabulary was made for a sign or signs which might have approximately the same or a related meaning. Promising signs were compounded or given a letter attachment. If the results were not "pleasing" to the sign creators, attempts were then made to develop entirely new signs. Obviously, this procedure is biased towards the modification of the existing sign vocabulary. Consequently, a "spontaneous" procedure designed to increase the probability of creating entirely new signs was devised.

For each term nominated, an English sentence was composed and printed on a 3 x 5 card. The sentences were constructed so that all words but the target term had an existing sign counter part. The target term usually came near the end of the sentence. Only "native-born" signers, deaf persons or persons who were born of deaf parents participated in this phase of sign generation. Each participant was instructed to sign every word in the sentence as rapidly as possible, including the target word. They were not to pause for the target word, merely to form a sign for it as spontaneously as possible. After receiving his instructions, the signer was given a stack of about 50 cards to read and "sign". This was recorded on video-tape. After completing the cards, the signer viewed a playback of his signs. He then judged whether each new sign should be retained and/or modified. Some interesting observations can be made about this procedure. Some individuals, intelligent and fluent

with the sign language as they might be, were able to create virtually nothing using this procedure. When they came to the target word they either stopped or resorted to spelling it. Others, while comfortable with the procedure, produced a very small number of signs. A few individuals, however, found the task easy and pleasant, and they created quite a number of attractive signs.

The next step in the process was to evaluate each new sign on the basis of its clarity and appearance. The signs were recorded on video-tape for subsequent showings to judges experienced in the use of the sign language. The judges evaluated each sign on two dimensions, clarity and appearance. Clarity was defined as the ease with which the sign could be read. This included distinctness from existing signs. Appearance was defined as the degree to which the sign was attractive to the judge. Usually, attractiveness seemed to be based upon graceful movement. Occasionally, a new sign might resemble or be associated in some way with a profane sign. This association invariably had a negative connotation. Only those signs judged very good or excellent on both dimensions were retained.

C. Sign Dissemination:

The principal tool used to teach the new signs to faculty and students was closed circuit TV. Basically, the instruction followed the same format as that used in the pilot study, i.e., a sign on TV, a pause during which the learner attempted to choose the correct English equivalent from a group of three on an answer sheet, and the showing of the English equivalent of the sign to provide the learner with immediate knowledge of results. This pattern was followed for all signs created for a single subject matter area. The first showing of the video-tape was considered the first trial, and performance on this trial yielded a measure of the recognizability of the signs. After a brief pause the signs were shown a second and then a third time. A fresh answer sheet was supplied for each showing. Performance on the second and third trials provided measures of learning . The students appeared to enjoy the first and second trials immensely. The task was pleasant and rather easy. So easy in fact, that the third trial had to be abandoned in the final year of this work because the great majority of students approached the ceiling of the test and became bored and restless. Consequently, in the final year of study, the fall session was limited to one recognition trial and one learning trial.

The students were tested again by the same procedures in the late spring in order to obtain a measure of their retenion of the signs. Very few upperclassmen returned for retesting. Many college preparatory students did return, however, for the test of their retention of the new signs. It seemed sensible to attempt to teach new students signs for more than one subject matter since English, mathematics and science are the subjects studied in their preparatory year. Finally, background information about their facility with the sign language was considered useful information. For all of these reasons, it seemed most appropriate to study retention with new students only.

In addition to the CCTV presentatations, it was thought desirable to supply a ready means of reference during the school year. Consequently, one or two sets of still photographs of the signs for the appropriate subject were prepared for each department to be used throughout the year. Unfortunately, the quality of the photos was mediocre and their limited number probably further reduced their effectiveness. It was simply not possible to produce the needed quality and quantity of references during the course of this experimental project.

RESULTS

A. Sample:

Gallaudet College students served as subjects for this research. The new students, about 85% of whom were preparatory or pre-college level, averaged about twenty years of age and had about a ninth grade average reading level.

A questionnaire designed to describe the student's background and acquaintance with the sign language was administered to all new students in the 1967-68 academic year. The questionnaire was revised somewhat for 1968-69. Since results from both years were similar, Table 1 presents only the 1968-69 data for new students. The most striking feature of the table is that only slightly more than half consider themselves "fluent" in the sign language. It is also clear that the great majority, slightly more than 70%, learn the sign language informally from friends and relatives. Probably of equal or greater importance are the statistics on when they learned the sign language. Fewer than one-fourth claim to have learned the sign language before they were five years old. The remainder of the group learned the language during their school years. Given the well established fact that deaf children have a very limited English vocabulary when they first enter school, these findings suggest that most deaf youngsters acquire virtually no language during those years when hearing children acquire so much of their language. In addition, the fact that more than three-fourths of the students learn the sign language from their friends or school staff instead of from their parents may affect emotional development as well. It is not surprising, therefore, that language problems are central to the education of the deaf.

B. Effects of Sign Language Generation Logics

As indicated earlier, it was deemed appropriate and useful to try to teach preparatory students a "basic vocabulary" of 92 signs of pre-college terms in English. science, and mathematics. The first two instructional trials were administered in a single, one hour session prior to the beginning of fall classes. The third trial came late in the spring seven months later.

Table 1

Background and Sign Language Fluency Information on 1968-69 Entering Students (N = 220)

Sign Language Ability	N	%
Fluent	114	52
Fairly Well	71	32
A Little	18	8
Not at all	14	6
No Response	3	2
Kind of School Attended		
Public Hearing School	58	26
Day School for Deaf	35	16
Residential School for Deaf	135	61
No Response	8	4
	(236)	(107)*
Age S. L. Learned		
0-5 years	51	23
6-10	79	36
11-15	38	17
16-20	28	13
over 20	3	1
No Response	21	10
From Whom Learned		
Parents	29	13
Staff	81	37
Friends	139	63
Other	13	6
No Response	9	4
	271	133*

* Some students attended more than one kind of school or learned the sign language from more than one kind of person.

Originally, five generation or construction rationales were followed during sign creation. A sixth, miscellaneous category, was added because spontaneous generation procedures yielded "mixed" signs. As indicated in Table 2, only a very small number of signs was developed in three of the six categories. It became necessary, therefore, to combine generation categories to obtain a reasonable number of signs in each category for purposes of analysis. Thus, both types of compounding were combined in a single analysis category as were the two totally new sign groupings. Four categories remained for the analysis.

C. Effects of Generation Rationales with New Students

The data secured for the new students was analysed as follows: Each student's score by category and trial was converted into a percentile score for that category and trial. Next, a fixed effects, repeated measure analysis of variance was separately conducted for each of the three trials. Finally, a Newman-Keuls test was made of the differences between all possible pairs of means within each trial. When differences between categories are cited, these differences are significant at .01 level of confidence.

The mean recognition (first trial) scores in Table 3 reveal that the students were able to recognize correctly about two-thirds of the signs upon initial presentation. Signs that were compounds of previously existing signs and letters were recognized more readily than signs developed by other means.

On the second or acquisition learning trial (see Table 5) the percentage of correct recognitions increased over the first trial from 22.3% to 26.8% depending upon analysis category. Students could recognize the signs correctly nearly 90% of the time. On this trial both the compounds and totally new signs were recognized better than the remaining two categories. It should be noted, however, that mean scores of 90% indicate that substantial numbers of the students "hit" the test ceiling, i.e., at or near perfect scores. While this degree of learning is gratifying, comparisons between categories become somewhat suspect.

Only 84 or slightly more than one-third of the preparatory students returned seven months later so that their retention of the new signs could be measured. Table 7 reveals that these students were able to recognize 75 to 85% of the signs. On this trial compounds were better retained than the letter modification and new sign categories, but not significantly better than those signs in the miscellaneous category. Thus, compounds were more correctly recognized on all three trials although the differences were never very great.

D. Direct Analysis of Learning and Retention for Preparatory Students

The foregoing section focused primarily upon the effects of the several gene-

Table 2

Reduction of Six Categories or Rationales Used to Create Signs to Four Categories for Analysis Purposes

Original Construction Categories	No. of Signs	Final Analytic Categories	No. of Signs
1. Compound of two signs	4	1. Compound	9
2. Compound of sign and letter	5		
3. Sign modified by letter	43	2. Sign modified by letter	43
4. New sign	29	3. New sign	31
5. New sign incorporating letter	2		
6. Miscellaneous	9	4. Miscellaneous	9
Total	92		92

Table 3

Means and Standard Deviations of Recognition (First Trial)
Percentile Scores for Preparatory Students (N = 209)

Analysis Category	Number of Signs	MEAN	S.D.
Compound	9	69.2	14.2
Sign Modified by Letter	43	62.9	10.1
New Sign	31	63.7	11.2
Miscellaneous	9	63.0	17.2
Total	92	64.7	13.7

Table 4

Analysis of Variance of Recognizability Scores

Source of Variation	SS	df	MS	F
Between people	74978	208		
Within people	81730	627		
Constr. Category	5627	3	1875.7	15.37*
Residual	76103	624	122.0	
Total	156708			

*F.99 (3, 624) = 3.78

Table 5

Means and Standard Deviations of Acquisition (Second Learning Trial) Percentile Scores for Preparatory Students (N = 201)

Analysis Category	Number of Signs	MEAN	S.D.
Compound	9	91.5	9.6
Sign Modified by Letter	43	86.8	9.1
New Sign	31	90.5	7.8
Miscellaneous	9	87.1	13.3
Total	92	88.98	10.2

Table 6

Analysis of Variance of Acquisition (Second Trial) Learning Scores

Source of Variation	SS	df	MS	F
Between people	45921	200		
Within people	40744	603		
Constr. Category	3363	3	1121.0	17.99*
Residual	37381	600	62.3	
Total	86665	803		

*F.99 (3, 600) = 3.78

Table 7

Means and Standard Deviations of Retention (Third Trial) Percentile Scores for Preparatory Students (N = 84)

Analysis Category	Number of Signs	MEAN	S.D.
Compound	9	79.8	12.7
Sign Modified by Letter	43	74.8	10.4
New Sign	31	75.1	11.2
Miscellaneous	9	77.6	16.0
Total	92	76.8	13.1

Table 8

Analysis of Variance of Retention Scores (N = 84)

Source of Variation	SS	df	MS	F
Between people	33870	83		
Within people	22403	252		
Constr. Category	1369	3	456.3	5.4*
Residual	21034	249	84.5	
Total	56273	335		

*F.99 (3, 249) = 3.78

ration rationales during the recognition, learning, and retention trials. This section is concerned with the direct analysis of recognition, learning, and retention of a large number (92) of signs without regard to generation rationale.

Since only 77 preparatory students participated in all three learning trials, it was judged necessary to compare their performance with that of the entire original group in order to determine if they differed in any significant way. The mean scores in Table 9 are very similar to the comparable means in Tables 3, 5, and 7. The standard deviations are slightly smaller and hence the group is a little more homogeneous. For all practical purposes, however, conclusions for this group should be applicable to the original entering group.

Table 9 shows in summary form that the group recognized a high percentage (63.6) of the signs on the initial trial, showed an absolute increment of 25.7% on the second trial, and retained 43.5% of that increment on the third trial (in the spring) after seven months of uncertain use by faculty and students. All of the mean differences are statistically significant. Somewhat surprisingly, the correlations between scores on the different trials are rather moderate. Thus, the correlation between the fall trials is .58 while that between the spring trial and each of the fall trials is .54. Very probably, the effects of guessing attenuated the reliability of the trial scores.

E. Analysis of the Effects of Generation Rationales and Academic Subject Matter and Recognition

It was possible to conduct first trial (recognition) sessions with majors from 12 academic departments. The means and standard deviations of the percentile scores for each of the 12 subject matters and the four analytic generation categories are shown in Table 10. As might be expected, there is considerable variation in the number of signs invented for each subject matter. This obtains for the generation categories as well. Indeed, there are generation categories in several different subject matters for which no sign was created. It is not possible to determine if this variation is a consequence of the specific terms and/or the skills of the individuals who invented signs for different subject matters. Nevertheless, the most striking feature of the data is that the students recognize upon initial presentation a very high percentage of new signs (78.6%). This probably is due to greater familiarity both with the subject matter and with the sign language itself.

To analyze these new signs by construction category and subject matter, it was necessary to arrange and modify the date summarized in Table 10 as follows: Any subject matter with a zero entry in any generation category or which was presented by fewer than six students was dropped from further analysis. The data for all remaining subject matters was restricted to six students by means of random selection. In effect, each subject matter was represented by an N of 6.

Table 9

Means and Standard Deviations of Percentile Scores on All Signs for Those Preparatory Students Who Participated in All Three Trials (N = 77)

Fall				Spring	
Trial 1 (Recognition)		Trial 2 (Acquisition)		Trial 3 (Retention)	
Mean	S.D.	Mean	S.D.	Mean	S.D.
63.6	8.9	89.3	7.2	74.8	9.0

Table 10

Means and Standard Deviations for All Students and All Subjects for Four Analytic Categories

		Compound	Sign Mod. by Letter	New Sign	Miscell.	Total
Art	M	70.0	86.2	77.8	0	78.0
(n=6)	SD	25.2	12.1	10.0	0	18.4
	k*	(5)	(12)	(18)	(0)	(35)
Bio.	M	76.2	88.75	70.6	81.2	79.2
(n=8)	SD	12.5	8.7	9.1	16.8	13.8
	k	(10)	(11)	(7)	(4)	(32)
Chem.	M	85.2	80.1	84.8	70.4	80.1
(n=27)	SD	15.8	9.3	10.1	31.1	19.9
	k	(6)	(30)	(18)	(2)	(56)
Drama	M	88.0	90.3	76.3	100	88.7
(n=6)	SD	8.5	12.4	16.04	0	13.5
	k	(11)	(12)	(7)	(1)	(31)
Eng.	M	84.6	74.1	79.7	74.2	78.1
(n=12)	SD	12.3	9.1	14.8	14.8	13.9
	k	(7)	(32)	(7)	(10)	(56)
Hist.	M	76.3	81.2	71.6	0	76.4
(n=12)	SD	19.9	9.6	13.1	0	15.2
	k	(6)	(14)	(9)	(0)	(29)
Lib. Sc.	M	88.3	63.9	88.9	100	85.3
(n=9)	SD	8.0	23.9	20.7	0	20.9
	k	(18)	(4)	(2)	(1)	(25)
Math.	M	95.4	56.9	77.0	96.6	81.5
(n=29)	SD	14.5	19.6	13.8	18.0	23.3
	k	(3)	(4)	(11)	(1)	(19)

* k = number of signs

Table 10 - continued

		Compound	Sign Mod. by Letter	New Sign	Miscell.	Total
P.E.	M	67	81.7	95.3	0	81.3
(n=7)	SD	0	12.8	11.6	0	15.4
	k*	(3)	(7)	(3)	(0)	(13)
Phys.	M	0	66.8	75.3	37.5	59.8
(n=4)	SD	0	23.5	15.5	21.6	26.2
	k	(0)	(3)	(8)	(2)	(13)
Psy.	M	82	78.9	84.6	43.8	72.3
(n=12)	SD	14.7	10.6	8.8	20.6	22.0
	k	(11)	(13)	(16)	(4)	(44)
Soc.	M	47.0	82.3	78.5	82.4	72.6
(n=17	SD	50.0	14.4	22.8	23.7	34.0
	k	(1)	(6)	(3)	(2)	(12)
Total	M	80.0	75.2	80.2	79.2	78.6
(n=145)	SD	26.3	18.	15.5	27.9	22.4
	k	(81)	(148)	(109)	(27)	(365)

* k = number of signs

The means and standard deviations for the remaining subject matters by generation category are presented in Table 11.

One further step was necessary before a fixed effect, two factor, repeated measure analysis of variance could be carried out. The percentile scores were subjected to an arc sin transformation to insure necessary distribution characteristics. A summary of the analysis of variance is given in Table 12. It can be seen that the variation between subject matters, generation methods, and the interaction between generation methods and subject matter are all significant. In short, recognizability of new signs will differ for different subject matters and different generation categories. As with the preparatory students, majors in the subject matter fields found compound signs easiest to recognize while the letter modified signs were least recognizable. The difference, again, is moderate, 8.4%.

CONCLUSIONS AND RECOMMENDATIONS

The results presented above suggest that the goals of this effort were achieved. It was demonstrated that a large number of new signs, 92 to be exact, could be taught effectively by means of closed circuit TV to a large group of entering Gallaudet students. Upon initial presentation, the students were able, on the average, to recognize the English equivalent of about two-thirds of the signs. After only one additional presentation, average recognition was approximately 90% correct. These results were achieved with a group of students only half of whom considered themselves fluent in the sign language. The group probably also included some who had difficulty with the English language vocabulary.

When the same type of presentation was used to teach new signs for a specific subject matter in 12 different subjects to juniors and seniors, the technique was even more successful. The upperclassmen, on the average, were able to recognize about 80% of the English equivalents upon initial presentation. This greater success can probably be attributed to increased fluency in the sign language and greater familiarity with the subject matter vocabulary.

A considerable amount of retention was also evident seven months later in a spring testing of the new students. At this time they recognized about three-fourths of the group of 92 signs. This represents a saving of 43.5% of the gain that they had achieved after their first learning session. As noted earlier, these results were achieved in an experimental setting with only one or two mediocre references available to the instructors.

It seems reasonable to assume that these new signs will be incorporated into the main body of the sign language if two conditions obtain:

1. The signs must be accepted by most adult users of the sign language.

Table 11

Means and Standard Deviations for the Two Factor, Repeated Measures Analysis (N = 6)

		Compound	Sign Mod.. by Letter	New Sign	Miscell.	Total
Bio.	M	73.3	86.5	70.3	83.3	78.4
	SD	9.7	8.6	6.3	18.6	13.3
	k*	(10)	(11)	(7)	(4)	(32)
Chem.	M	94.5	82.2	93.3	83.3	88.3
	SD	12.3	5.5	7.4	23.7	15.3
	k	(6)	(30)	(18)	(2)	(56)
Drama	M	88.0	90.3	76.3	100	88.7
	SD	8.5	12.1	15.9	0	13.7
	k	(11)	(12)	(7)	(1)	(31)
Eng.	M	78.7	72.8	68.8	66.7	71.8
	SD	11.1	8.3	9.9	12.5	11.5
	k	(7)	(32)	(7)	(10)	(56)
Lib. Sc.	M	87.2	75.0	91.7	100	88.4
	SD	7.6	14.4	18.6	0	15.6
	k	(18)	(4)	(2)	(1)	(25)
Math.	M	94.5	50	77.3	100	80.4
	SD	12.3	25	19.7	0	26.0
	k	(3)	(4)	(11)	(1)	(19)
Psy.	M	83.5	78.3	81.3	45.8	72.2
	SD	13.2	10.5	9.6	17.2	20.2
	k	(11)	(13)	(16)	(4)	(44)
Soc.	M	83.3	80.5	77.7	83.3	81.2
	SD	37.3	11.3	31.6	23.6	27.8
	k	(1)	(6)	(3)	(2)	(12)
Total	M	85.4	77.0	79.6	82.8	81.2
	SD	17.8	17.3	18.8	23.6	19.8
	k	(67)	(112)	(71)	(25)	(275)

Table 12

Analysis of Variance of Two Factor, Repeated Measure Design

Source of variation	SS	df	MS	F
Between subjects	24.81	47		
A (subject matter)	9.43	7	1.35	3.55*
Subjects within groups	15.38	40	.38	
Within subjects	44.01	144		
B (constr. methods)	3.39	3	1.13	5.65*
AB	16.89	21	.80	4.00*
Bx subjects within groups	23.73	120	.20	

* $p < .01$

2. Reproductions of the signs must be clear and readily available as teaching and reference materials for both beginning and experienced users of the sign language.

To meet both conditions, a book containing attractive and clear line drawings of the new signs was prepared for wide distribution. The book, Signs for Instructional Purposes, by Kannapell, B. M., Hamilton, L. B., and Bornstein, H., was labeled and indexed in both English and French. Four thousand copies were printed and are in the process of being distributed without charge to the relevant staffs of all post-secondary schools with special programs for the deaf, to appropriate personnel in the secondary programs at the public residential schools for the deaf in the United States and Canada, to participants in the National Association of the Deaf training program for professional workers with the deaf, to all interpreters on the Registry of Interpreters for the Deaf, to the entire Gallaudet complex, to international workers and educators of the deaf recommended by the editor of the American Annals of the Deaf, the World Confederation of the Deaf, and the Director of Council of Organizations Serving the Deaf.

The book has been well received. As mentioned in the introduction to this report, interpreters report that the new signs are particularly welcome and useful. Although experimental evidence is not, and will not, be available it seems highly probable that they will become a part of the sign language.

The final part of this report deals with some of the characteristics of the sign language itself. Basically, it was desired to enlarge the sign language to include signs to represent English terms appropriate to high school and college level vocabularies. The generation or invention procedures followed yielded the following results (from the totals of Table 10): 43% were existing signs modified by manual alphabet letters; 22% were compounds of existing signs and/or letters; 29% were entirely new signs; and 6% were a miscellaneous combination of the previous categories. In short, about 70% of these new signs represent minor modification or combinations of existing signs. In part, this reflects the procedures used to develop the new signs, but it also suggests that the existing sign language has a great deal of explanatory power even for the rather abstract vocabulary involved in this study.

The other major conclusions which may be drawn from this study are that differences in recognizability, acquisition, and retention of new signs can be attributed to the method by which these new signs were generated. Compounds were superior to other forms when measured against the learning criteria used in this study. However, the differences were relatively small and probably should not seriously affect the acceptance and use of any kind of sign into the sign language.

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APPENDIX

HOW TO USE THIS BOOK

The signs have been grouped into four educational divisions or clusters of subjects: (1) Science and Mathematics, (2) Humanities, (3) Social Sciences, and (4) Professional Studies. Each educational division, in turn, has a section devoted to words common to all of the subjects within that division as well as sections for terms in specific subject matters. We recommend that teachers, students, or interpreters interested in a subject, learn both the common and specific terms. For example, if you are interested in learning the signs for Biology, you should study the terms common to Science and Mathematics as well as those in Biology.

An alternate and more direct way to locate any specific sign is to consult the alphabetical index at the back of the book.

So that a larger audience might find this book useful, we have labeled each sign in English and French. The index is also expressed in both languages. (An omission indicates that there is no known French equivalent.)

We tried to make each pictured sign sufficiently descriptive so that a reader could reproduce it without further help. In each picture, the solid lines represent the initial hand position and configuration. Dotted lines stand for later or final hand configurations.

For those who might profit from additional description, we have developed a simple, supplementary notation to accompany almost all of the illustrations. This notation is not a complete symbolic representation of the sign language, as can be found in the **Dictionary of American Sign Language,** by Stokoe, Casterline, and Croneberg. It is merely a supplement to the illustrations.

This is the notation:

When a letter in the English alphabet is used as a part of the sign, that letter is capitalized and followed by a subscript indicating the direction that the hand moves. These are the directions:

t = toward the body
a = away from the body
u = upward
d = downward
s = sideways

Example: H_s means the letter H moved sideways.

(→) Existing sign is modified (usually with a letter).

Example: element = E → basic
The new sign for the word "element" is existing sign for "basic" modified by the letter E.

(+) A compound of signs or of a letter and a sign.

Example: bond = B + join
The new sign for "bond" is a compound of the letter B plus the sign for "join".

(•) Both hands are involved in the sign. Left hand shape described to the left of the dot; right hand described on the right of the dot.

Example: plot = P • P → build
The new sign for "plot" is made with the left hand forming the letter P and the right hand using the existing sign for "build" modified by the letter P.

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